

Notes on the Insects taken on the Cocos-Keeling Islands

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The Cocos-Keeling islands have been known since the beginning of the sixteenth century. At this period they were uninhabited, and such insects as were present must have been carried to the group by wind or sea currents. Andrews's study (1900) of the fauna of the neighbouring Christmas Island, which is in approximately the same latitude and relatively rich in terrestrial species, shows that the steady set was from the area due east, the region of the Timor Sea and its islands. By 1896-7, relatively little had reached it from the nearest land mass, Java, which is 180 miles further north. The Cocos-Keeling Islands are much further from the Sunda group; the nearest point is the south end of Sumatra, 550 miles to the north-east. Accordingly species blown by abnormal winds, as the visiting Odonata are, have appreciably further to travel, and an even greater proportion of the terrestrial fauna should have been derived from the Timor Sea area. Unfortunately the Cocos-Keeling Islands probably have relatively few indigenous species. No exhaustive collecting was done before the settlement was fully established, as Andrews, through the generosity of Sir John Murray, was able to do on Christmas Island. Nevertheless it would seem that a large proportion of the insects now on the atoll must owe their presence there to man's activities.

The Cocos-Keeling Islands remained uninhabited until the early part of the nineteenth century. The first settlement, which was only a temporary one and lasted less than a year, was made by a Captain Le Cour of the brig *Mauritius*, early in 1825. The next settlement, which proved permanent, was made by John Clunies-Ross and Alexander Hare in 1827. During the succeeding years the island was in trade contact with Mauritius, and to a lesser extent Java. Later, in the time of the second Clunies-Ross (owner 1854-71), the contact with Mauritius ceased and until the turn of the century the islands were almost entirely dependent on the Javanese ports, and occasional boats sailing direct to or from Europe. In addition the Clunies-Ross family maintained a small settlement on Christmas Island from November 1888 to 1899. Trade with Singapore also became increasingly important from this period onwards. During the World War of 1914-18 the fourth Clunies-Ross (owner 1910-44) lost his schooner, which was stolen by escaping members of

the crew of the German light-cruiser *Emden*, and subsequently sold his other Ocean-going boat. These were not replaced after 1918, and in the inter-war period the islands depended on a part-charter of the vessel supplying the Cable Station on Pulo Tikus. This normally made three trips a year to and from Singapore, by way of Christmas Island. In the early days of the settlement, therefore, ship-jumping insects might have reached the main atoll from Mauritius or Java. Subsequently the opportunities were largely restricted to Java and Christmas Island, and finally to Singapore and Christmas Island.

There is no real soil on the Cocos-Keeling Islands, but in places the coral clinker of which the low-lying islands are built is covered with a thin layer compounded of decayed vegetable fibres and finely powdered sand. This supports a fairly dense vegetation in which the coconut palm predominates. Mixed with it are clumps and flanking strips of several of the more widespread tropical sea-shore trees and shrubs. It is not, however, suitable for most forms of cultivation, and for this reason soil has been taken to parts of Pulo Selma, where the native village is situated, Pulo Luar and Pulo Tikus, to provide an adequate growing medium for introduced fruit trees and vegetables. From the earlier accounts of the settlement it would appear that initially soil was fetched from Mauritius. Presumably at this stage it went to Pulo Selma. Later when Christmas Island was inhabited, it was taken from there. No precise records are extant and it is not, of course, clear how much was carried, but it would seem that the Clunies-Ross family deposited an appreciable amount on Pulo Selma, and probably some on Pulo Luar, where the third owner (1871-1910) established a vegetable garden. The Cable Station on Pulo Tikus began importing soil in the nineteen-twenties. In the succeeding decade it was receiving about two shipments a year, of 100 bags each, dug from the jungle on Christmas Island. These were used to form a small but most successful vegetable garden just over an acre in extent. Some insects may, therefore, have reached the Cocos-Keeling Islands from Mauritius in the earlier part of the nineteenth century, or later from Christmas Island, in soil carried to the atoll, in addition to those which were introduced by passage in the trading boats.

Charles Darwin visited the main atoll from 1-11 April 1836, in the course of his travels in *H. M. S. Beagle*. In his account of the atoll (1845: chap. 20) he says "Of insects I took pains to collect every kind. Exclusive of spiders, which were numerous, there were thirteen species. Of these, one only was a beetle. A small ant swarmed by thousands under the loose dry blocks of coral, and was the only true insect which was abundant". He gives his list of 13 species in more detail in a foot-note, "In the

Coleoptera, a minute *Elatér*; *Orthoptera*, a *Gryllus* and a *Blatta*; *Hemiptera*, one species; *Homoptera*, two; *Neuroptera*, a *Chrysopa*; *Hymenoptera*, two ants; *Lepidoptera nocturna*, a *Diopæa*, and a *Pterophorus*(?); *Diptera*, two species." This is an extremely meagre list, in spite of his pains. There is no doubt that just over 10 days was not long enough for him to have gathered all the insects present, and probably such examples as the *Odonata* were arriving then, as now, at certain seasons and failing to establish themselves. At the same time it should be remembered that Darwin was on the atoll on what would, in a normal year, be the rainy season, when the majority of the insects are most evident. In addition, in 1941 I had only 3 days on the isolated island of North Keeling, during which the greater part of the time available was devoted to the birds. Nevertheless I found examples of 6 *Diptera*, 1 *Hymenoptera*, 3 *Coleoptera*, 4 *Lepidoptera* and 2 *Orthoptera* (a cockroach and a cricket), making a total of 16 species. Finally Darwin makes no mention of termites, mosquitoes, flies of the family *Muscidae*, the Copra Beetle or the Blister Beetle, all of which he could not have failed to notice if they had been as plentiful as they were in 1941.

On the whole it would seem that the island must have had an extremely limited insect fauna in the early days of the settlement. Obviously the rapid increase has been due largely to the transport of insects in the trading vessels. In part it may also have been occasioned by the greater richness and variety of the vegetation following the establishment of fruit trees and gardens, which provide food for wind-born forms that could not otherwise maintain themselves on the atoll. Wood-Jones (1912: 310) gives two cases, very similar to each other, to support this contention. While he was collecting there tomato seeds were sent out from England. Large numbers of the larvae of a moth new to the atoll began to attack the leaves shortly after the appearance of the first crop of plants. The moth in question, *Plusia chalytes* Esq. (*tom. cit.*: 352), is widely spread, but it does not occur in England, and it can hardly have been introduced with the seeds. The same consequences followed the establishment of peas by means of seeds with a different, but again widely distributed, moth.

The second naturalist to visit the atoll was Dr. H. O. Forbes who stayed on Pulo Selma from 18 January to 9 February, 1879. He also attempted to collect the insects, but unfortunately his specimens were lost on the way back to Java (Forbes, 1885: 30-31). He is, however, able to give a partial account of the insects present in 1879, without precise identifications or figures. It would seem that several additional *Coleoptera* had made their appearance, a shorthorn grasshopper, several *Diptera* including

an *Asilus* sp. and a number of Lepidoptera. The latter included the Atlas Moth, which has certainly not been recorded by subsequent visitors. The only Hymenoptera that he found were ants, but these were abundant—"a minute Fire-ant (*Camponotus*), the common Javan Long-legged venomless species and several black sorts". He also notes that a Termite had spread to the islands. In general insects were obviously more numerous in species, and more conspicuous in numbers, than at the time of Darwin's visit, but apparently there were still no mosquitoes, and the beetles did not include either the Copra Bug or the unpleasant *Sessinia* sp.

Order			Darwin 1836	Wood-Jones 1905-6	Gibson-Hill 1941
Orthoptera	..	..	2	13	15
Dermaptera	..	..	—	1	c. 4
Isoptera	..	..	—	1	2
Odonata	..	..	—	3	3
Hemiptera	..	..	3	7	c. 15
Neuroptera	..	..	1	1	1
Lepidoptera	..	..	2	33	c. 72
Coleoptera	..	..	1	17	c. 56
Hymenoptera	..	..	2	c. 6	17
Diptera	..	..	2	12	c. 35
Total ..			13	c. 94	c. 220

This table shows the numbers of species, in the different orders, reported from the collections made in 1836 (ten days), 1905-6 (fifteen months) and 1941 (ten and a half months). Some of the orders in 1941 collection have not been worked over yet, and the figures, prefixed by "c.," are only approximate. A few species taken by earlier workers were not collected again in 1941, and the total number known from the islands is therefore about 230.

The next collection was made by Dr. F. Wood-Jones between June 1905 and September 1906, almost 80 years after the establishment of the settlement. Nearly all his material reached London, and reports on it appear in the Proc. Zool. Soc. Lond. for 1909, pp. 144-157 (reprinted in Wood-Jones, 1912: 349-66). Allowing for an ant which was lost this gives a total of 94 species. The great increase, as is shown in the accompanying table, is in the Orthoptera, Lepidoptera, Coleoptera and Diptera. Wood-Jones only has 3 ants and 3 wasps, where Darwin had one of each, and the Neuroptera are still represented by the single bright green Lacewing Fly, which appears to have been plentiful at all times. On the other hand he is able to list both *Sessinia* sp. and *Corynetes rufipedes* De Geer (The Copra Beetle) among the Coleoptera, and a species of *Stegomyia* (= *Aedes*), existing in great numbers, among the Diptera, all minor pests which

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could not have been overlooked in a short stay, and must have reached the atoll after 1879. He also gives 5 Rhophalocera, of which only 3 were seen in 1941.

In 1879 J. G. Clunies-Ross gave Forbes to understand that the number of kinds of insects was increasing at a noticeable rate. In 1905-6, on the other hand, he told Wood-Jones that in his opinion there had been no additions to the fauna in recent years. Partly on this Wood-Jones himself suggests (1912: 228) that the great increase which his list shows on those of his predecessors was largely due to "a more thorough and prolonged collecting". Certainly the points are important, and a stay of more than a full year is bound to yield a number of species that could not be obtained in a visit of a few weeks. Even then Wood-Jones's contention is unacceptable. More material could be collected casually on North Keeling in 3 days in 1941 than Darwin, taking pains, was able to find on the main atoll in 10 days in 1836. In addition several of the more troublesome insects occurring in and near the settlement were not noted before Wood-Jones's survey, and others before Forbes's. No one could have missed the mosquito *Aedes* or the Copra Beetle *C. rufipedes* in a day on Pulo Selma if they were present as they were in 1941. Darwin, who wrote rather contemptuously of the atap huts in the settlement, would certainly not have overlooked the Termite, or the house-flies, if they had been present. Finally the 1941 collections, made over a period of only 10½ months, show a considerable increase over the totals achieved by Wood-Jones in 1905-6. All the collections have not been worked out yet, but the total number of species represented is approximately 217 against 94 for 1905-6 and 13 for 1836. Even if one trebles Darwin's figure, to compensate for the shortness of his stay, it would seem that the insect population of the atoll has expanded considerably since the formation of the settlement, and that expansion is still going on. From the nature and rate of the extension it must be due very largely to ship transport, and to the effects of modifications of the vegetation which are allowing wind and sea-borne strays to establish themselves, when previously they would not have been able to do so.

References

- ANDREWS, C. W. 1900. A Monograph of Christmas Island (Indian Ocean). British Museum (N. H.), London.
- DARWIN, C. 1845. Journal of Researches during the Voyage of H.M.S. Beagle Round the World, Chap. 20. London.
- FORBES, H. O. 1885. A Naturalist's Wanderings in the Eastern Archipelago, pp. 11-47. Sampson Low, Marston, Searle and Rivington, London.
- WOOD-JONES, F., et al. 1909. The Fauna of the Cocos-Keeling Islands, *Proc. Zool. Soc. Lond.*, 1909 (1), pp. 132-160.

WOOD-JONES, F. 1912. Coral and Atolls, 2nd ed. Reeve, London. (Includes a reprint of the faunal papers in the *Proc. Zool. Soc. Lond.* of 1909).

The following sections give more detailed notes on some of the orders represented in the 1941 collections. Unfortunately they do not cover the complete insect fauna of the Islands. Some of the specimens and field notes disappeared between 1942-46, and specialist's identifications have not yet been received in the case of the Orthoptera, Dermaptera, Hemiptera, Neuroptera, Diptera and the majority of the Lepidoptera.

Order—ISOPTERA

Wood-Jones (1912: 364) records one unidentified Isoptera from the Cocos-Keeling Islands. Field observations showed that there were certainly two species present in 1941. Both were fairly plentiful in their respective habitats. Specimens from the nests were submitted to Prof. A. E. Emerson, of Chicago, in 1949 and he has kindly provided the identifications used below.

A small number of winged forms taken with other insects at light traps were also sent to Prof. Emerson. These are dried specimens in poor condition, and a precise determination is not possible. According to Prof. Emerson the majority are a *Kaloterme* nov. sp., presumably alates of the second species listed below. With them was one imago of a *Cryptoterme* sp. of which no other evidence was found in the course of my collecting on the atoll.

Prorhinotermes canalifrons (Sjöstedt).

Soldiers, workers and third form reproductives. This species is well known from Madagascar, Mauritius, the Seychelles etc., but had not previously been recorded from this region.¹

1. The complete list of records of *Prorhinotermes canalifrons* (Sjöstedt) is as follows,

Madagascar: Tamatave, Majunga, Ivoloïna.

Seychelle Islands: Mahe, Long Island; Praslin, Amiranten; Poivre;

Aldabra.

Mauritius: Pointe d'Esny.

Chagos Archipelago, Salomon Island.

Cocos-Keeling Islands.

The genus *Prorhinotermes* is almost wholly confined to islands. The only two places where it is found on a continent are in southern Florida and on the coasts of Central America (Panama, Costa Rica). In these latter cases the species are always found within a few miles of the coast. I suspect the species are distributed in floating logs (or by man in boats). They survive in the islands with small competition, but cannot get a foothold on continents with heavy competition, so they are absent from Australia, the Malay Peninsula, India, Africa etc., but are known from the outlying islands in all these regions. (Prof. A. E. Emerson, *in litt.*, 24: 2: 50).

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In 1941 it was present on all the islands in the main atoll of the Cocos-Keeling group except Pulo Luar. The nest was generally found in the rotting stumps of dead coconut palms; the majority of the stumps also contained colonies of a small black ant.

Kaloterme nov. sp.¹

Soldiers and nymphs.

Plentiful on Pulo Selma and Pulo Tikus. It usually occurs in houses and stores, hollowing its nest out of the woodwork of pillars, roof-beams and floors, or the sides of boxes and crates; but I also found three nests in the trunks of rotting Ironwood Trees, *Cordia subcordata* Lam. This species builds very few external tunnels, and relies almost entirely on excavation. It is accordingly difficult to detect it at work. This would appear to be the termite which Wood-Jones found "abundant in the woodwork of dwelling-houses" in 1905-06.

Order—ODONATA

Three species of dragonfly appear, at certain seasons, on the Cocos-Keeling Islands but, as on Christmas Island, there is no suitable freshwater and they do not breed locally. They always arrive in the few days of calm following an easterly or north-easterly wind. Both the wind and the short period of ensuing calm seem to be essential, and if the former drops back to the south-east too quickly no dragonflies are seen. The commonest of the species, *Pantala flavescens*, may appear in vast swarms at any suitable point through the year. The other two, according to native tradition, supported by the observations of both Wood-Jones and myself, usually arrive only in or about May. It is also believed locally that there is a set order for their appearance, *Anax guttatus* arriving one or two days after *Pantala flavescens*, and *Tramea rosenbergii* about two days after *Anax guttatus*. This certainly occurred in May 1941.

Pantala flavescens (Fabr.).

Local Malay name, *Kēchapong* (*Bētul*).

This is easily the most plentiful of the three species. Not only does it arrive on the islands more frequently than the other two, but it reaches them in far greater numbers. A large swarm appeared suddenly on 29 April, and during the following week *P. flavescens* was abundant in the clearings and open spaces on all the principal islands. It could even be found, in considerable numbers, flying over the lagoon, and several examples were observed at sea about four miles from the atoll. After the first

¹ Prof. Emerson is at present working on this genus and expects to draw up descriptions for publication in the course of the next two years.

week they became appreciably less plentiful, and by the end of a month there were no dragonflies to be seen. Smaller swarms, lasting for about a fortnight, also appeared on 26 January and 23 October.

This species also occurs, in a similar manner, on Christmas Island, where at certain seasons it is very plentiful.

Tramea rosenbergii Brauer.

Local Malay name, *Bonek*.

This species is far less common than the preceding. It first appeared on 3 May and during the following four days it became increasingly numerous; but it was never as plentiful as *P. flavescens* and the swarm disappeared much more rapidly. In flight the two species are rather similar, though *T. rosenbergii* has a slightly redder tinge and seems to flutter more. At rest they can be distinguished very easily, the present species always alighting on the top of an almost vertical dead stick or branch, and retaining its wings and body in a horizontal plane. *P. flavescens* alights anywhere, at any point on a branch, living or dead, and usually allows its tail to drop so that its head is higher than its body.

I never saw this species in two years on Christmas Island, and it was not recorded from there by Andrews. Wood-Jones' record for the Cocos-Keeling Islands is very similar to mine. He first observed *T. rosenbergii* on 16 May (1906), and during the following week it became abundant, but for nearly a year previous to that it had not been seen.

Anax guttatus (Burm).

Local Malay name, *Rajah Kēchapong*.

This is the least common of the three dragonflies arriving on the islands. A few hundred appeared on 1 May, mostly on Pulo Tikus and Pulo Selma, but by 3 May they had practically all disappeared. Wood-Jones recorded only about a dozen examples, occurring in May (1906).

Andrews on Christmas Island (1897-1898) saw only two or three specimens, of which he caught one. In two years (1938-1940) there, I did not observe any.

Order—LEPIDOPTERA

Superfamily Papilioninae¹

The present collection contains examples of three species of Rhopalocera, all of which also occur on Christmas Island. All three seem to be resident on Cocos, but there are apparently annual as well as seasonal variations in their numbers. *Precis*

¹ I am most grateful to the late Dr. A. S. Corbet for reading through this section of this paper in December 1947, and making several very helpful comments, which have been incorporated in the text.

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villida villida, which Wood-Jones (1912: 349-350) describes as the commonest butterfly on the atoll, was, in 1941, the least numerous of the three.

Wood-Jones also recorded two further species, *Hypolimnas misippus* Linn. and *Vanessa kershawi* McCoy, which are not represented in the present collection. The latter was undoubtedly a stray. During a stay of fifteen months, Wood-Jones saw only four specimens, all of which were observed between 15 and 17 May, 1906. Two were caught and are now in the British Museum collection; both are rather worn. *V. kershawi* is generally regarded as the Australian race of *V. cardui* (Linn.): the British Museum collection also includes four specimens taken by Dr. C. W. Andrews on Christmas Island in September 1908².

The case of *Hypolimnas misippus* is somewhat different. At the time of Wood-Jones's visit it was certainly resident on the atoll. He found it distributed over all the islands in the group, and abundant from February to April and again from July to October. The females were mimics of *Danaida chrysippus* L. forma *petilia* Stoll, and were nearly always seen flying in company with that species. Larvae were discovered on a succulent weed, which he was not able to identify, and some were reared to maturity. In the absence of exact information about the food plant, it is possible that the latter has been cleared so extensively that the species has become extinct, but this is most unlikely. There has not been much weeding and clearing in the coconut plantations during the last thirty years. What is more probable is that this species is subject to extreme degrees of annual variation in its numbers, and that though still present in 1941, it was temporarily so scarce as to be overlooked. Or it may, like *Colias edusa* and *C. hyale* on the south coast of England, be unable to maintain itself satisfactorily for more than a generation or two (owing to unfavourable climatic conditions), and be dependant on the periodic arrival of fresh individuals. On Christmas Island I observed it between April and June, 1939, and took six specimens, five in very good condition. I never saw it at any other time during the remainder of my two years' stay there. Andrews, who was on Christmas Island for nearly eleven months, from 1897-1898, only obtained one worn specimen. Tweedie, in August-September 1932, failed to find it, although he obtained a most excellent collection of the other species found by Andrews, and added four additional names to the list of those recorded from the island. Ridley (*Journ. Straits Br. R.A.S.*, 1905: 150), on the

2. I am indebted to Dr. Corbet for this record which does not appear to have been published before. I was not aware of it when writing on the butterflies of Christmas Island (*Bull. Raff. Mus.*, 1947: 74-80), and the species should be added to the list given there on the fauna of that island.

other hand, describes it as "very abundant" on Christmas Island in the latter half of October, 1904. As he appears to have taken no specimens, I had assumed that he had confused it with *H. bolina*. There is, however, no doubt about Wood-Jones's record from the Cocos-Keeling Islands (specimens were sent to F. A. Heron for identification and a female was retained in the British Museum collection); it therefore seems probable that Ridley's observation was valid. If that is so, *Hypolimnas misippus* can be taken as occurring on both Christmas Island and the Cocos-Keeling group, but subject to such extreme variation in numbers, from one cause or another, that in some years it may be overlooked even when an extensive search is made for it.

Danaida chrysippus L. forma *petilia* Stoll.

This was easily the commonest butterfly during the eleven months in which I was on Cocos. It disappeared entirely during the more prolonged spells of rainy weather, but as soon as drier conditions re-established themselves it became plentiful. It was particularly numerous in January, at the end of an abnormally long dry season. It occurs mostly over the more open parts of the islands, particularly in the neighbourhood of flowering plants. Its flight is low and fluttering, and it seldom rises more than four or five feet above the vegetation. Females seemed to be slightly commoner than males.

Larvae were found in January, May and September. They were feeding on *Hujan Mas*, *Asclepias curassavica* Linn., and *Rémigu*, *Calotropis gigantea* R. Br., but there must be other food plants, as neither of these are sufficiently well distributed over the atoll or, except on Pulo Selma, sufficiently plentiful. They were a slightly yellowish, pale green, banded with yellow and black: the long, thin horns were black. The pupae were pale green with a band of small, metallic, gold-coloured dots. The imago emerged after $5\frac{1}{2}$ -7 days.

Precis villida villida (Fabr.).

This butterfly was plentiful in April and May, and again at the end of August and the end of October, but it virtually disappeared during the intervening months. It occurred almost exclusively over the open, bare, windswept portions of the islands, and I never found it amongst the coconut palms. It always flew close to the ground, and often settled on the dry grass for long periods. The frequency of the sexes was about equal.

Larvae were found early in May on *Asystasia coromandeliana* Nees. This plant also occurs on Christmas Island, but there I found them only on garden Verbena.

Hypolimnas bolina bolina (Linn.).

This butterfly was plentiful in May, and again at the end of August, on both occasions occurring in dry spells following periods of rainy weather. A few scattered specimens were also seen at other times between May and September, and a female was taken on North Keeling on 5 July. It is a strong flier, and it was often observed round the heads of the coconut palms. The frequency of the two sexes was about equal, though it was usual to see more males on one day, and more females on another.

The small series which I obtained showed far less variation, in both size and colour, than the one collected on Christmas Island (Gibson-Hill, *Bull. Raff. Mus.*, 1947: 77-79). All the specimens belonged to the wet season form. The males ranged only from 75 mm. to 83 mm. across the wings, while the colour pattern was typical and constant. The females ranged from 75 mm. to 92 mm., and nearly all had a large pure white blotch, with a suggestion of pale blue along its proximal border, in the centre of the dorsal surface of the hind-wing. The British Museum has 2 males and a female taken on the Cocos-Keeling Islands by Wood-Jones. The female agrees with the above description, and resembles the figure of the Javanese ♀-form *iphiphenia* (Cram.) in Seitz (*Macrolepidoptera of the World*, 9, plate 118, d 1) except that the orange patch on the upperside of the forewing is more extensive. Wood-Jones's specimens of the genus *Hypolimnas*, apart from those identified as *H. misippus*, were recorded by Heron as *H. bolina* and *H. bolina* form *Nerina*. The first entry has no field-note appended to it: the second is described as an uncommon species, on the wing in April and August, and, from the perfect condition of the specimens, evidently resident on the atoll. Dr. Corbet (*in litt.*) expresses the opinion that both the Cocos-Keeling and the Christmas Island *H. bolina* should all be referred to the nomotypical form. The male of *H. b. bolina*, in the wet season phase, is like *nerina*, while some of the wet season females differ only in having the orange-brown patch on the primaries smaller. *H. bolina listeri* was described by Butler (*Proc. Zool. Soc. Lond.*, 1888: 542) as *Hypolimnas listeri*, but in the *Monograph of Christmas Island* (1900: 62) he changes its name to *Hypolimnas nerina* var *listeri*, on the strength of this resemblance, and attempts to enumerate six distinct variations to cover the wide range of pattern. Actually, as a large collection shows, none of these variations are clear-cut, and it is possible to arrange a graded series running between any two extremes.

Three larvae of *H. b. bolina* were found in May on the leaves of *Pisonia* sp., probably *Pisonia excelsa* Blume. They were in

the fourth instar, and jet black in colour, with the spines a bright, slightly orange, yellow. The pupae were reddish brown, with the projections faintly tinged with gold. One imago emerged, early in the morning, on the ninth day.

Order—HYMENOPTERA

Five species of Formicidae now occur abundantly on all the islands in the main atoll, and a sixth apparently on Pulo Tikus only. The remaining families are represented by eleven species, of which one, a *Tachysphex* sp., was very plentiful. Wood-Jones (1912: 355-6) records examples of three Sphegidae (a *Stizus* sp., *Pison hospes* and *Notogonidea subtesselata*) and two ants (*Odontomachus haematodes* and *Plagiolepis longipes*), but unfortunately some of his specimens of Formicidae were mislaid; these two probably do not represent all the species which were then on the atoll. He says that the Malays recognised at least three—*Sēmut Aman*, *Sēmut Api* and *Sēmut Alus* (? *Sēmut Rengga*)—and it is quite possible that the majority of the six species at present on the islands were there by 1905-06.

I am indebted to Mr. H. T. Pagden, senior entomologist, Department of Agriculture, Kuala Lumpur, for identifying the Formicidae, and to the Commonwealth Institute of Entomology, London, for identifying the other specimens (List No. 2192 Asia; Coll. No. 11231).

SPHEGIDAE

Pison hospes Smith.

Plentiful on all the islands. No nests were discovered on uninhabited portions of the atoll; but it was making use of every nook and cranny in the houses, filling all suitable key-holes, bolt-stops and similar places with a fine grey-brown cement. On three occasions I had the tube of my stethoscope blocked in less than thirty-six hours. All the finished cells that were examined contained spiders; the majority were young *Nephila imperatrix* C.K., or adults of a small species very common in the neighbourhood of the buildings. A number of wasps were observed carrying food to enclose in their nests, and in all cases it was a spider.

Tachysphex sp.

Wood-Jones did not find this wasp but, although difficult to catch, it is now fairly plentiful on all the islands.

Notogonidea subtesselata Smith.

Fairly common on Pulo Tikus, Pulo Atas and Pulo Panjang in July and August. Recorded by Wood-Jones (1912: 356).

Stizus proximus Handl.

Fairly common on Pulo Panjang, Pulo Luar, Pulo Selma and Pulo Tikus in May and June. Presumably the *Stizus* sp. of Wood-Jones's list (1912: 355), "very near *reversus*, Smith."

Nitela pendleburyi, Turner.

A single specimen was taken on Pulo Tikus in February.

Trypoxylon geniculatum, Cameron.

A single example taken on Pulo Tikus, early in January.

FORMICIDAE

Odontomachus sp. ?*haematodes* L.

Local Malay name, *Sēmūt Aman*.

The largest of the ants on the atoll. It was plentiful on all the islands, and especially numerous on Pulo Panjang. It generally builds its nest under piles of fallen coconuts or, more rarely, atap. Its bite was said to be more painful than that of *Sēmūt Api*.

Plagiolepis longipes Jerd.

Local Malay name, *Sēmūt Rengga*.

This species is very common on all the islands. It usually builds its nest under fallen atap, and like *Sēmūt Aman* appears to occur only in the coconut plantations. It moves about mostly at night.

Solenopsis geminata F., var. *rufa* Jerd.

Local Malay name, *Sēmūt Api*.

Very common on all the islands, and especially plentiful on Pulo Luar. It usually builds its nest in sandy earth under coral boulders, and constructs long foraging tunnels, just beneath the surface of the ground, in search of food. Occasionally it is found in houses, particularly if the floors are covered with matting. It appears to be equally active by day or night. It has an unpleasant, burning bite, from which it earns its name, the pain being worst about a minute after the ant has been removed.

(not determined. Coll. No. 1).

Local Malay name, *Sēmūt Hitam*.

This ant is much addicted to sugar. It is very plentiful in the heads of the coconut palms, and is always present on the fruit of *Morinda citrifolia* L. and similar plants. It also occurs in houses, especially on Pulo Selma, but less frequently than *Sēmūt Podak*.

(not determined. Coll. No. 5).

Local Malay name, *Sēmūt Podak*: from a fancied resemblance between the colouring of the dorsal surface of the abdomen and the fruit of the Pandanus.

This ant was found only in the houses. It was very plentiful on Pulo Selma, but much less numerous on Pulo Tikus. Like *Sēmūt Hitam* it is attracted by sugar and syrup. It moves about mostly at night.

(not determined. Coll. No. 6).

This species, which is not known to the Malays and has no local name, builds its nest in the soft, tunnelled wood of rotting, though still living, trees; mostly the Cocos ironwood, *Cordia subcordata* Lam. I only found it on Pulo Tikus, where it was fairly common.

CHALCIDIDAE

Gen. near *Anthrocephalus* sp.

Dirhinoides pachycercus Masi.

These wasps were fairly common on Pulo Tikus in January, February and early March, and again in August and September, but I did not notice them during the intervening months.

PTEROMALIDAE

Chaetospila elegans, Westwood.

Fairly plentiful in September and October.

EULOPHIDAE

Entedoninae, ? gen.

A single specimen was taken at the end of September.

EVANIIDAE

Evania appendigaster, L.

Two examples taken on Pulo Tikus in September. A third was seen at the same time.

Order—COLEOPTERA

Examples were taken covering about 56 species of Coleoptera. Unfortunately the field notes to this collection have been lost, and only a list of identifications can be published here. A preliminary diagnosis of the specimens, producing precise identifications in the case of 38 species, has kindly been made by members of the staff of the British Museum (Natural History), particularly M. Balfour Brown, E. A. J. Duffy and H. E. Hinton. Examples of 12 species, marked with an asterisk in the list below, have been retained in the British Museum.

All the species taken belong to the sub-order Polyphaga.

NOTES ON THE INSECTS TAKEN ON THE COCOS-KEELING ISLANDS

Superfamily STAPHYLINOIDEA

Family Staphylinidae.¹

Medon sp.*

Philonthus sp.*

Scimbalium sp. (?nov.)*

Family Histeridae.

Paromalus gardineri Scott.*

Superfamily DIVERSICORNIA

Family Nitidulidae.

Carpophilus maculatus Murr.

Carpophilus humeralis F.

Carpophilus nitidus Murr.

Family Cryptophagidae.

Paramecosoma sp., or Gen. nov. aff.*

Family Lathridiidae.

Corticaria sp., not in B.M. coll.*

Family Colydiidae.

Bitoma parallela Sharp.

Family Coccinellidae.

Coccinella transversalis F.

Sticholotis 4-signata Weise.

Pullus coeruleipennis Sic.

Pullus ?arrowi Sic. (verisim.)*

gen. incog., not in B.M. coll.*

Family Endomychidae.

Trochoideus desjardinsi Guer.

Family Lucanidae.

Figulus ?rossi Gahan.

Family Dermestidae.

Telopes undulata Mots.

Attagenus gloriosus Fab.

Orphinus defectus Walk.

Family Cucujidae.

Monanus ?concinnulus Walk.

Family Buprestidae.

Chrysodema simplex Wat.

1. M. Cameron det.

Family **Hydrophilidae.**

Dactylosternum abdominale Fab.

Family **Cleridae.**

Necrobia rufipes Deg.

Family **Lyctidae.**

Minthea rugicollis Walk.

Family **Elateridae.**

Heteroderes triangularis Eschsch.

Melanoxanthus melanocephalus Fab.

Melanoxanthus sp. (cf. *alluaudi* Fleut.).*

Superfamily **HETEROMERA**

Family **Tenebrionidae.**

Ceropria induta Wied.

Gonocephalum sp.

Platydema sp.

Alphitobius laevigatus F.

Tribolium castaneum Herbst.

Family **Edemeridae.**

Ananca sp.

Sessinia canella Fairm.

Family **Anthicidae.**

Anthicus sp., not in the B.M. coll.*

Superfamily **PHYTOPHAGA**

Family **Bruchidae.**

Bruchus analis F.

Family **Cerambycidae.**

Dihammus nativitatis Gahan.*

Superfamily **RHYNCHOPHORA**

Family **Anthribidae.**

Araecerus fascicularis Deq.

?*Araecerus* sp.

Family **Curculionidae.**

Cylas formicarius Fab.

Acalles sp.

Oxydema subcaudata Fairm.

Calandra oryzae L.

NOTES ON THE INSECTS TAKEN ON THE COCOS-KEELING ISLANDS

Family Scolytidae².

Xyleborus perforans Woll.
Rhizeperthola dominica Fab.

Superfamily LAMELLICORNIA

Family Scarabaeidae.

Oryctes rhinocerus L.
Protaetia acuminata F.
Anomala dimidiata Hope.
Anomala sp.

Family Aphodiidae.

Aphodius lividus Oliv.
Rhyssemus inscitus Walk.

Family Copridae.

Onthophagus trituber Wiedem.
Onthophagus liliputanus Lansb.

² D. J. Atkinson det.